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The Genus Asimina.*

ASA GRAY.

One object of this communication is to ask for fruits of the southern shrubby species, which seem to have been rarely collected. I possess ripe fruit of only one of these, namely, A. parviflora. Another object is to set right the generic character, in particular that of the æstivation of the corolla.

Formerly one of the diagnostic characters of the order Anonaceæ was the valvate æstivation of the petals. Their evident overlapping in the flowers of our so-called Papaw was one reason for dissenting from the conclusion of the old Flora of North America, where *Asimina* was reduced to a section of *Uvaria*, and restoring the genus in the Genera Illustrated. Since then it has been ascertained that all the genuine species of Uvaria have their petals imbricated in the bud, as I had suspected of some of them, and that in this they accord with several other genera; so that, indeed, Mr. Bentham, in the Genera Plantarum, brought them together to form his tribe *Uvarieæ*. It was purely my fault, as is recorded on p. 68 of the fifth volume of the Journal of the Linnean Society, that he did not include in it the genus Asimina. Misled by an imperfect observation, making sections of the lower part only of some flower-buds, I informed him that I had "ascertained that they were truly valvate." The fact is that, in this, as in many other genera of the order, the petals are of comparatively late growth; in the young bud they are distant, later their lower portion may come merely into contact and so give the idea of valvular æstivation of each series; but when they grow up and cover the globular mass of the genitalia, their summits overlap somewhat largely in the imbricative manner. At least this is the case in A. triloba, and I find it essentially the same in the long- and narrow-leaved species which I name *A. angustifolia*. The following notes which I made upon living plants of A. grandiflora, in Florida, in the spring of the year 1875, show the same thing, with some difference. "Outer petals with their tops well overlapping in the early state of the bud, one external, one intermediate, one interior, and remaining so as they enlarge; down their sides only contiguous, their bases distant; in anthesis enlarging greatly. Petals of the inner series remote in the bud, enlarging only moderately, remaining erect, never coming into contact, their margins above the middle becoming revolute as they grow, and thus not actually overlapping.

* Issued May, 1886.

Their base becomes more and more deeply concave within, where it develops protuberant longitudinal and roughened ridges. The flowers as they open are much frequented by thrips or other small vermin, which are attracted to this secretive surface. The anthesis is strongly protogynous. The stigmas are effete much before any pollen is shed, which, indeed, takes place only when the anthers loosen and separate as they begin to decay and fall." I did not notice that the blossoms were "sweet-scented," though Bartram so describes them. The scent of the flowers in the genus is generally unpleasant.

Notwithstanding Baillon's view, it seems evident that our plants are not congeneric with the Old World Uvariæ. Asimina seems to be well characterized by the dissimilar petals of the two series; the outer always larger, much accrescent, thin and veiny, and spreading, while the inner are concave and erect, mostly of thicker texture, at least at the concave or almost saccate base, and quite different in shape, although the difference is least in A. triloba and A. parviflora.

I have not seen the Australian *Fitzalania* of Mueller, which is said to have small inner petals, and their texture is not described. I have not sufficient materials for a proper investigation of the Cuban species, which Grisebach referred to Asimina. Their coriaceous and nearly homogeneous petals forbid their union with our genus, but they may belong to the still obscure genus Porcelia. Nothing can be determined respecting the place of Baillon's *Uvaria Hahniana*, of Mexico, until its flowers are known. As to Seemann's *Sapranthus* of Nicaragua, of which we have flowers collected by the late Charles Wright, by no means as large as those figured by Seemann, the homogeneous petals, all six alike, plane, thin, veiny, and equally accrescent, would seem to indicate a genus as distinct from Porcelia as from Asimina. I will conclude these remarks with a synopsis of the species of Asimina, as they now appear to stand. But further observations are needed on some of them.

ASIMINA, ADANS.*

* Flowers from the axils of the deciduous leaves of the preceding year; these amole, acute or acuminate at both ends, thin, the reticulation of veinlets inconspicuous: petals moderately accrescent, from green becoming brown-purple, ovate or roundish; the inner moderately concave and nearly even within, not very much smaller: the first a tree or shrub; the second a low shrub.

A. triloba DUNAL. Pedicels about the length of the middle-

*As to the French-colonial name, *Assiminier*, Mr. Gerard of New York informs me that it was adopted from the Ojibway Indian name of the fruit of A. triloba.

sized flowers: styles distinct, introrsely stigmatic at and below the tip: ovules numerous in two rows: seeds flat.

A. parviflora DUNAL. Pedicels very short and flowers much smaller: petals less accrescent: stigma sessile on the ovary: ovules about 10, nearly in a single series: seeds few, turgid.

** Flowers from the axils of less deciduous leaves (commonly in pairs or accompanied by a leafy shoot from the same axil); these furfuraceous-tomentulose when young, retuse or obtuse, becoming subcoriaceous in age, then with conspicuous reticulation of veinlets: petals white, very unlike in size and shape; the outer much accrescent and membranaceous, roundish and at length obovate; inner thicker, saccate-concave at base, the concavity purple or pink and conspicuously rimose-corrugate longitudinally; stigma sessile and depressed: low shrubs.

A. grandiflora DUNAL. Leaves when young with both sides (as well as the shoots) tomentulose: leaves spatulate-oblong to obovate or oval: outer petals 2 inches or more long when full-grown, 3 or 4 times the length of the revolute-margined inner ones.

A. cuneata SHUTTLEWORTH in distrib. coll. Rugel. Less pubescent: leaves smaller (an inch or two long) and mostly narrower, glabrate, even the nascent ones glabrous or nearly so above: pedicels solitary: outer petals only an inch long, about twice the length of the inner.—Pine barrens of S. Florida; first coll. near Lake Monroe, in young fruit only, by *Rugel*, no. 8. Several years later in flower, by *Palmer*, *Havard*, and apparently by *Feay*, if it is *A. reticulata* Chapm., Fl. Ed. 2, 603, as I suppose from the description.

*** Flowers in the axils of extant subcoriaceous and subsessile reticulate-venulose leaves: outer and inner petals very unlike; those of inner series rimose-corrugate in the concavity, as in the preceding section: ovaries distinctly styliferous and 8 to 10-ovuled: fruit not seen: glabrous under-shrubs (rarely some minute pubescence): the flowering stems mostly simple and hardly woody, but springing from a woody base or stock.

A. angustifolia. Stems 2 or 3 feet high, erect: leaves elongated, from narrowly linear (and 5 or 6 inches long by 2 to 4 lines wide) to narrowly spatulate: flower white, large, commonly erect: outer petals much accrescent, 1½ to 2 inches long, oblong; inner much narrower and smaller, lanceolate above the saccate-concave internally purple-spotted base: ovaries almost glabrous.—This is the *Orchidocarpum pygmæum* of Michaux, in part, perhaps mainly, and the *Asimina pygmæa* figured by Dunal in his monograph, also in part the *Uvaria pygmæa* of Torrey & Gray's Flora. Good specimens of it were distributed in Curtiss's col-

lection as *A. pygmæa*, var., no. 87*. But it is not the original *Annona pygmæa* of Bartram, as his description and good figure show. Shuttleworth and his collector Rugel discriminated the species, but, following Dunal, took it for *A. pygmæa*, and so gave new names to the old species of Bartram. It is not rare in the sandy pine woods of Florida. In setting the species right I am obliged to give it a new name.

A. pygmæa DUNAL, Monogr. 84, as to syn., etc. Stems a foot or two high, commonly declined or arcuate: leaves from cuneate-linear to oblong, 1 to 4 inches long, half inch to full inch wide, reticulated: flower greenish turning purple, strongly nodding: outer petals moderately accrescent, at most half inch long, ovate and becoming ovate-lanceolate, not broader nor more than half longer than the ovate inner ones.—*A. pygmæa* largely of authors, and of Curtiss distrib. no. 87. *Annona pygmæa* Bartram, Trav. ed. Amer. 18, t. 1, the figure and description both unequivocal. Bartram says that "the flowers both in size and colour resemble those of the Antrilobe." *Antrilobe* is a puzzle, but I guess it to be a printer's mistake of *An. triloba*. The foliage varies greatly. The commoner narrow-leaved form figured by Bartram was named by Shuttleworth *A. secundiflora*. A form with small and comparatively broad leaves is his *A. reticulata*.

Revision of the North American species of Nuphar.

THOMAS MORONG.

(WITH PLATE VI.)

Along the shores of Lake Champlain there grows a species of Nuphar, which has long been a puzzle to botanists. It has been variously regarded as *N. luteum* Sm., *N. luteum*, var., *N. Kalmianum* Pursh, and *N. intermedium* Ledeb. Some have pronounced it a hybrid. This Nuphar first attracted my attention two years ago in the Adirondack regions of New York, where it was very abundant in Little Tupper lake and the adjoining waters, Rock Pond and Charley Pond Since then botanical friends have sent it to me from Ottawa, Canada, from Lake Memphremagog and other places in the Northern States.

Last summer I spent a portion of my vacation in collecting and studying this plant at Ferrisbergh, Vt. It occurs plentifully at that point in the mouths of Lewis and Little Otter creeks, and thence along the Vermont shore to Missisquoi Bay. There

is also a specimen in the Gray herbarium, which was collected not far from Philadelphia, Penn.

This form appears, therefore, to be widely distributed in the eastern part of the northern United States.

It has also been noticed in some of these localities for quite a number of years. Prof. H. G. Jesup speaks of having observed it at Missisquoi Bay in 1872, and so long ago as 1856 Prof. Caspary had occasion to notice an American Nuphar in the gardens at Kew, England, which I judge to have been this form.

The study of this plant has led me to some very interesting conclusions.

The first noticeable fact is, that it is immediately associated, and so far as I know or can learn, *invariably* associated with two other species, *N. advena* Ait. and *N. Kalmianum* Ait.

The second fact is, that it appears almost exactly intermediate in all its parts between the two associated forms. The plate accompanying this paper shows this very clearly. The stigmatic shield or disk of N. Kalmianum is distinctly star-shaped, the rays separated half way down, that of N. advena is crenate or waved at the margin, while the intermediate form has a shield, the margin of which is more deeply crenate than that of the one, and yet not so deeply cut as that of the other. I find a variation in the specimens as though the shields ran now towards one form and now towards the other in this particular. The fruit of the intermediate form, as a general thing, resembles that of N. Kalmianum, but the neck and shoulders exhibit a tendency towards N. advena. The other organs speak for themselves in the drawings.

Curiously, too, the disk colors of N. advena and N. Kalmianum when growing seem to blend in the other, being in the first pale red, in the second dark red, and in the third a beautiful bright red or crimson. This is not seen in herbarium specimens, as in the process of drying they all become uniformly dark.

The next fact is, that this intermediate form, as I found it in the Adirondacks, produces *no fruit*, or scarcely any. After a long and careful search in all the localities in that region, I could find only a single imperfectly developed pericarp, and that had but two or three ripened seed in it, while the associated species bore an abundance of good fruit. The pollen of the intermediate form, also, when examined under the microscope, proved to be unsound. The same defect has been found in specimens of this plant gathered in Canada. Prof. Caspary, of Königsberg, Prussia, to whom flowers were sent by J. Fletcher, Esq., of Ottawa, reported to him that out of 155 grains of pollen examined he

found 95 per cent. bad. This accords nearly with my own determination. We have, therefore, good physiological as well as morphological evidence that this Nuphar is in *these* localities a hybrid between N. advena and N. Kalmianum.

But how is it with the same plant in Lake Champlain? It still remains associated with the other two species, but in some spots it has wandered to the distance of a mile or more from the others. At Ferrisbergh it is even more abundant than the parental forms. *It also bears an abundance of well developed fruit.* I collected dozens, and could have collected scores of full, ripe berries. The grains of pollen in the freshly opened flowers were scattered freely over the stigmas, and proved, when examined microscopically, *as sound as those of either* N. advena or N. Kalmianum.

I am therefore led to believe that in this locality, on Lake Champlain at least, the hybrid *has been developed into a good species*, perfectly capable of propagating itself by seed; while in other places it still remains a hybrid and infertile. It seems to me that we have the transition complete, first the association of two species, next a mule progeny, and finally a new and perfect species.

I have accordingly ventured to regard it as an undescribed species, and to call it N. rubrodiscum from its bright red stigmatic disk.

To account for the blending of the two parental species in so many instances, we are to remember the unusual facility of intercourse between them, which is possibly aided by some special innate tendency to assimilate. The flowers of both are very conspicuous on the surface of the water, for one thing, and when in fresh blossom the corolla is frequently full of small winged insects. I scarcely opened a flower but I found a host of these visitors either upon the stamens or the nectaries. I also noticed a variety of aquatic insects which seemed to make their home upon the leaves and stalks, and to dispute possession of the flowers with their winged rivals. Now here we have a means of spreading the pollen from one flower to another, which is no doubt very effective. The plants also flower all summer long, beginning in May and continuing till September. Besides this they grow generally in quiet water and sheltered nooks where they are protected from disturbing winds and waves. We should therefore expect just such results as we have if there were any hybridizing tendency at all in the species.

I have been led on by interest in these three related forms to look up the other North American species of Nuphar, and the following is offered as a revision of the genus:

Nuphar SMITH. Flowers yellow, cup-shaped, single on a stalk which rises to the surface of the water, with the odor of the orange: sepals 5–12, the outer partly greenish on the outside and often ruddy within: petals one or more rows, small, stamen-like, nectary-bearing beneath, inserted with the stamens upon the receptacle around the ovary, sometimes gradually changing into stamens: stamens numerous, in 3–9 rows, at length recurved; anther cells linear, adnate, introrse: the ovary rising at the summit into an urceolate circular or stellate disk, upon which lie 8–21 stigmas in radiating lines or ridges: fruit an ovoid or globular berry, its apex often oblique to the body, having as many cells as there are stigmas, many seeded, the oval seeds without aril. The leaves at base deeply lobed, with a sinus nearly $\frac{1}{3}$ the length of the blade (except in no. 5), the floating coriaceous, the submerged thin, crisped and broadly cordate, rising from a thick scaly looking rhizome which creeps widely under the mud.

An inhabitant of pools and muddy streams, flowering all summer; of 7 or 8 species in the North Temperate Zone.

1. **N. advena** AIT. Flowers $1\frac{1}{2}$–2 inches in diameter when expanded: sepals oblong or cuneate, unequal, the largest $1\frac{3}{4}$ inches long: petals fleshy, oblong or dilated towards the truncate apex, 4–5 lines long by 2–3 wide: stamens 5–7 rows; anther equaling the filament: stigmas 12–20, on a level with the surface of the disk or slightly raised above it, occasionally not reaching more than half way to the margin; stigmatic disk waved on the margin, pale red when fresh: fruit without a neck under the disk, the largest about 2 inches long by $1\frac{1}{4}$ inches in diameter: leaves smooth, sometimes pubescent beneath, roundish or ovate, 5–12 inches long by 5–9 inches broad, the sinus usually open; the petioles and peduncles smooth or slightly pubescent; rhizome covered with the scaly scars of former leaves.

Var. (?) **minor.** Specimens without leaves are in Herb. Gray which have flowers about one inch in diameter when expanded, the disk margins more deeply crenate, ten stigmas, and small fruit an inch long by one-half an inch broad.

They are labelled "Smith's Pond, Herkimer Co., Litchfield, New York." Further material is very desirable.

The species is common in the Atlantic States and occurs as far west as the Uinta Mts., Utah, and northward.

2. **N. rubrodiscum.** Sepals similar to the foregoing, the largest $1\frac{1}{2}$ inches long by $1\frac{1}{4}$ wide: petals more dilated upwards or even spatulate or obovate, 3–4 lines long by 2 lines broad: the anther about equal to the filament: stigmas 9–12 ridges; disk more deeply crenate than in the preceding, a beautiful bright red or crimson

when fresh, the stigmas lighter in color: fruit with a narrow neck under the disk, about an inch long by an inch diameter: floating leaves vary from 3 to 8 inches in length and 2 to 6 in breadth, the sinus open or closed, occasionally pubescent beneath; submerged leaves orbicular.

N. luteum Gray Man. non Sm. The true *N. luteum* Sm. has larger flowers, petals larger and generally more obovate, and stamens larger with broader filaments, as shown in the plate.

Lake Champlain, Vt. Intermediate between N. advena and the following, and produced from a hybrid between them. Still a hybrid in many localities.

3. **N. Kalmianum** Ait. Smaller than N. rubrodiscum, flower an inch broad or somewhat less when expanded: sepals 6–7½ lines long: petals thin and delicate, spatulate or obovate, about 2 lines long by 1 broad: stamens 3 and 4 rows, narrowly linear; the anthers occupying only ¼ of the length: stigmas 7–10 ridges of a golden color upon a dark red stellate shield, which is 2–3 lines in diameter: floating leaves from 2–4 inches long and from 1–3 broad, commonly more or less pubescent beneath, the sinus open or closed; submerged leaves circular, very thin.—Ait. f. Hort. Kew. 3, 295.

N. pumilum Caspary, Ann. Mus. Lugd. Bat. 2. 256. Macoun's Cat. Can. Pl. *non* Smith. *N. luteum* Sm., var. *pumilum* Gr. Man. 57. *N. lutea*, var. *Kalmiana* T. & Gr. Fl. 1. 58.

A beautiful little plant which occurs from Newfoundland to Penn. and as far northwest as the Saskatchewan. It bears a strong resemblance to the European N. pumilum, but that differs from our plant morphologically in having the filament much thinner and broader, and the anther broader and shorter. The difference is shown in the plate. The European plant also is commonly much more pubescent. When crossed the two plants produce a hybrid, showing a physiological difference.

4. **N. polysepalum** Engelm. Flowers the largest of the genus, 2–5 inches across when open: sepals 7–12, the largest 2 inches long and nearly as broad: petals 12–18, thick, often reddish, 5 lines long by 3–4 wide, dilated upwards, truncate: stamens 7–9 rows, 5–6 lines long by 1 wide; anthers truncate, equaling the filament: stigmatic disk deeply urceolate, with entire or crenate margins, often pubescent on the top, the stigmas hardly reaching the margins: fruit smooth, ovoid, 1–2 inches in diameter, contracted into a short neck under the disk: seeds rather small as compared with those of N. advena: leaves smooth, broadly ovate, 7–12 inches long by 5–9 broad, the sinus open or closed: peduncles and petioles smooth or pubescent, generally quite pubescent when young.—Trans. Acad. St. Louis, 2. 282.

This species is found from Colorado to California and thence northward

to Alaska. The seeds are said by Dr. J. S. Newberry to form the principal winter subsistence of the Indians.

5. **N. sagittifolium** PURSH.—Flowers small, about an inch across when expanded: sepals 5: petals dilated upward, about 3 lines long by 1½ wide: stamens 4 or 5 rows; the anthers about ½ their length: stigmas 11–15 ridges on a disk with crenate margins: fruit ovoid, without a neck under the disk, the largest an inch in length: leaves olive-green, smooth, oblong, rarely ovate, broadly obtuse at the apex, sagittate, the sinus $\frac{1}{10}$ the length of the leaf; the floating varying from 8 to 15 inches long by 2 to 3 broad; the submerged larger and more numerous: the petals sometimes transformed into stamens.—PURSH, 370.

Confined to the Southern Atlantic States from North Carolina to Florida.

EXPLANATION OF PLATE VI.—The figures are drawn from herbarium specimens and are enlarged one-third.

1. Sepal of N. advena. 2. Two forms of petals of same, both common, one showing the nectary on the back. 3. Stamen of same. 4. Stigmatic disk of same. 5. Sepal of N. rubrodiscum. 6. Two forms of petals of same, both common, one showing the nectary. 7. Stamen of same. 8. Stigmatic disk of same. 9. Petal and stamen of the European N. luteum. 10. Sepal of N. Kalmianum. 11, 12, 13. Petals, stamen and stigmatic disk of same. 14, 15. Petals and stamen of the European N. pumilum. 16. Fruit of N. rubrodiscum. 17. Fruit of N. Kalmianum, one of the berries oblique, as is frequently the case in all the species. 18. Fruit of N. advena.

Grasses of Yellowstone National Park. I.

F. LAMSON SCRIBNER AND FRANK TWEEDY.

The following grasses were collected by Mr. Tweedy, of the U. S. Geological Survey, during the seasons of 1884–85, and he has also furnished the notes upon the distribution of the species. Sets of the grasses here enumerated were sent to Dr. Asa Gray, to the Academy of Natural Sciences of Philadelphia, and to the U. S. Department of Agriculture.

1. (263, 580.) PANICUM DICHOTOMUM Linn. var. PUBESCENS Gray, Man. p. 649. *P. pubescens* Lam., Michx. Flor. 1.49; Torr. Flor. U. S. 144; Steud. Gram. 86. *P. thermale* Boland. Proc. Calif. Acad. II, p. 181. Very common over the hot spring and geyser areas, often forming matted, carpet-like masses around the borders of the springs themselves.

This variety should perhaps be kept distinct from *P. dichotomum* L., but until a more thorough study can be given the interminable diversity of forms presented by the *P. dichotomum* of American authors, and careful comparisons made with the types of the species founded by Lamark, Kunth and others, any attempt to classify them will be worse than useless.

2. (579.) PHALARIS ARUNDINACEA Linn. (Coulter's Manual, p. 40). Bogs, Yellowstone Lake, rare.

3. (648.) HIEROCHLOA BOREALIS R. & S. (Coulter, Man. 406).—Mountain meadows from 8000 to 9000 ft. alt., not common.

4. (591.) ALOPECURUS OCCIDENTALIS, n. sp.—"*A pratensis*, var. *alpestris* Wahl. (*A. glaucus* Less.) ex Gray," Thurber in list of Hall and Harbour's Rocky Mountain plants. *A. alpinus* Porter and Coulter, Flor. Col. p. 251; Coulter, Man. p. 406.

A tall erect grass, usually glaucous throughout, with thick ovoid heads. Stems 60–90 cm. (or, in very dry soil, 20–30 cm.) high, erect, sheaths smooth or finely scabrous, much shorter than the internodes, loose, at least the upper ones, but not inflated. Ligule 1–2 mm. long. Leaves erect or ascending, 5–15 cm. by 4–7 mm., flat except at the cartilaginous and sharply pointed apex, smooth beneath, scabrous on the prominent nerves above. Panicle usually long exserted, sometimes partially enclosed in the upper sheath, 2–3 cm. long and half as thick. Spikelets 3.5–4.5 mm. long (usually about 4 mm.), the rather abruptly acute empty glumes equaling or slightly exceeding the obtuse flowering glume, which is scabrous and more or less ciliate near the tip. Awn about 6 mm. long, smooth and twisted below, more or less bent near the middle, scabrous above.

Mirror Lake Plateau, alt. 8800 ft. Rather common in mountain meadows, associated especially with *Phleum alpinum* L. In similar situations in Montana this grass is not infrequent, sometimes covering large areas to the exclusion of other species. In the mining regions it is cut for hay, for which purpose it is highly esteemed under the name of "mountain timothy."

I have seen no specimens of *Alopecurus glaucus* Lessing, but our grass certainly does not agree with the diagnosis of that species given by Grisebach in Ledb. Flor. Ross. IV, p. 462, nor in all respects with that of Steudel in Syn. Gram. p. 150. It is a much taller plant than *A. alpinus* Sm., to which it is most nearly allied, and besides its glaucous color and more rigid foliage, the hairiness of the glumes is less woolly in character, and the awn is always more developed. The true A. alpinus has not yet been found within our limits. The plant in question differs from A. pratensis in its shorter and more ovoid spikes, more hairy, less conspicuously nerved and shorter empty glumes, and in the comparatively shorter and more obtuse flowering glume. *Alopecurus arundinaceus* Poir. (*A. ruthenicus* Weinm., *A. nigricans* Hornem.), a species which our plant resembles in habit, has a more cylindrical spike, and differs especially in having the acute tips of the less hairy empty glumes curved outwards, and further also in the much shorter awn.

5. (592.) ALOPECURUS GENICULATUS Linn., var. ARISTULATUS Torr. Flor. U. S. p. 97, Niccolet's Rept. p. 163. *A. aristulatus* Mx. Flor. I, p. 43; Gray, Man. p. 608; Coulter, Man. p. 407. Wet shores of ponds and banks of streams. Cache Creek, alt. 6800 ft., Turbid Lake alt., 7900 ft.

Although ranked as a species by most American authors, we are disposed to consider this grass a variety only of the Linnæan species. The points of difference are its usually more erect habit, more slender spikes or rather panicles, smaller spikelets and generally shorter awn. In these particulars it is essentially *A. fulvus* Smith. In A. geniculatus the spikelets are about 3 mm. long and the outer glumes are usually *longer* than the floret; in the variety the spikelets are scarcely more than 2 mm. long while the flowering glume is as long as or slightly exceeds the outer ones. The awn varies from being nearly obsolete to twice the length of the spikelet.

6. (262, 609, 613.) STIPA VIRIDULA Trin., Act. Petrop. 1836, p. 39; Thurber in S. Watson's Bot. Calif. II, p. 288. *S. parviflora* Nutt. not Desf. *S. spartea* Hook. Fl. Bor.-Am. II. 237, not Trin. (*teste* Thurber.)—Meadows, Mammoth Hot Springs, alt. 6200 ft., Sour Creek, alt. 8000 ft., junction of the East Fork and Soda Butte Creek, alt. 6700 ft. Common everywhere over the dry open areas up to 8000 ft. altitude.

This grass varies a good deal in height of stem, length of leaves and size of panicle, but it is readily distinguished from the other species of the region by its strict, rather densely flowered and generally elongated panicle, and small spikelets. It is a valuable forage plant, as it does not possess the long and very sharp-pointed rhachilla below the flowering glume which renders *S. spartea* Trin. ("porcupine grass") so injurious to stock.

8. (611.) STIPA RICHARDSONI Link. Hort. Berol. 2, p. 245; Coulter, Man. 408.—Soda Butte, alt. 6800 ft., comparatively rare or local. This is a very graceful species with short leaves, slender stems (60–90 cm.) and a nodding purplish panicle of widely spreading few-flowered branches. Spikelets 8–9 mm. long—the length of the lowest glume, which is nearly twice the length of the flowering glume. The latter is thinly covered with short hairs, rests upon a very short and obtuse (or acute) rhachilla, and terminates in a slender, scabrous, once or twice geniculate awn, 12–20 mm. long.

8. (610.) STIPA COMATA Trin. and Rupr., var. INTERMEDIA. Flowering glume including the rhachilla at the base 15 mm. long, awn about 7 cm., straight beyond the geniculations. A form intermediate between S. comata and S. spartea, but belonging rather to the former.

Junction Butte, alt. 6000 ft., growing with S. viridula, but less common.

In both Stipa spartea and S. comata the rhachilla below the flowering glume is 4–5 mm. long and is densely pubescent except at the very sharp point. In S. spartea the usually dark colored flowering glume is of very firm texture, and, excepting for a line of rather stiff hairs near the margins that often extend its whole length, is very smooth and shining above; the awn is very strong and rigid and nearly straight beyond the geniculations. In Stipa comata there is no distinct line of hairs on the pale green flowering glume, but its entire outer surface is thinly covered with short silky hairs; the rather slender awn is much elongated beyond the geniculations in the type, and more or less curled. In S. spartea the panicle is long exserted, the branches strictly erect and one to two flowered. In S. comata the base of the somewhat spreading one-sided panicle is never entirely free from the upper sheath.

The variety named above resembles some forms of *Stipa setigera* Presl., but in that species the palea is hyaline, and scarcely one-third as long as its glume There are other characters of difference, but this alone will serve to distinguish the two.

9. (615.) ORYZOPSIS ASPERIFOLIA Michx. Fl. 1. 64; Gray, Man. p. 617. (Not in Coulter's Manual.)

Pine woods, Soda Butte creek, rare.

10. (614.) ORYZOPSIS EXIGUA Thurber in Botany of Wilkes' Exped. p. 481. (Not in Coulter's Manual.)

On rocky bare knolls along Slough Creek; alt. 6700 ft. Not seen elsewhere.

This is a densely tufted grass with slender wiry stems 15–25 cm. high. It has much the habit and appearance of *Oryzopsis Canadensis* Torr., but differs essentially in its simple and contracted panicle, its shorter outer glumes, and in its longer and somewhat persistent awn.

11. ORYZOPSIS CUSPIDATA Benth. Jour. Linn. Soc. XIX, p. 82; Coulter, Man. 410. *Eriocoma cuspidata* Nutt. Gen. I, p. 40. *Urachne lanata* Trin. Panic. p. 126.—Sparingly scattered over the low and dry open areas.

12. (649.) PHLEUM ALPINUM Linn.; Coulter, Man. 410.—Bogs and meadows, common between 8000 and 9000 ft. altitude.

13. (590.) SOROBOLUS DEPAUPERATUS Scribn. in Torr. Bull. IX, p. 103. *Vilfa depauperata* Torr. in Hook. Flora Bor.-Am. II, 257, t. 236.—Common about Yellowstone Lake.

14. (605.) AGROSTIS VARIANS Trin. Agrost. II. 68; Thurber in S. Wats. Bot. Calif. I, p. 273. (Not in Coulter's Manual.) —Bogs, Mirror Lake plateau, common.

15. (258, 606, 607, 608.) AGROSTIS SCABRA Willd.; Coulter, Man. 412.—Meadows and dry slopes, very common up to alt. 8000 ft.

The more common form of the species is represented by no. 258. No. 607 is a low (10–20 cm.) densely cespitose form with short and subulate radical leaves (*Trichodium subulatum* Nutt. in Herb. Phila. Acad.). No. 606 is an unusual form, and is referred to Agrostis scabra only after very careful comparisons and examinations. It has the rather short and very narrow radical leaves and the characteristic spikelets of that species, but the cauline leaves are comparatively broader and longer, especially the uppermost one, and the panicle is also narrower and apparently more densely flowered. The panicle is 6–10 cm. long, with 3–5 unequal (1–5 cm.) branches at each joint which, with the pedicels, are not so decidedly scabrous as in the type.

16. (604.) AGROSTIS EXARATA Trin. Agrost. II. 87: Thurb. in S. Wats. Bot. Calif. II. 273; Coulter, Man. 412.—Wooded bogs and along mountain streams, not common.

The specimens distributed were gathered near Pelican creek, alt. 8000 ft. They differ considerably from the type as figured by Trinius (Icones t. 27), but the limits of the species are not clearly understood, a great variety of forms having been referred to it, this along with others.

17. (259, 603.) AGROSTIS HUMILIS Vasey in Torr. Bull. X, p. 21. (Not in Coulter's Manual.)

Cool mossy bogs and mountain meadows, alt. 7000–9000 ft., rather common.

This very well marked and pretty little species, has the rhachilla produced behind the palea into a short naked bristle, a character not noted in the original description. (It is No. 671 Hall & Harbour.)

18. (581.) CINNA PENDULA Trin. *C. arundinacea* L. var. *pendula* Gray; Coulter, Man. 413.—Wooded bogs and streams, East Fork, alt. 8600 ft., not common.

This species is at once distinguished from C. arundinacea by its smaller (4 mm. or less) spikelets and equal or nearly equal outer glumes. In many specimens examined, both from New England and from the northwest, we have found the rhachilla prolonged behind the palea into a short naked bristle. Mr. Tweedy collected in Washington Territory a variety (var. *glomerula* Scribn. Proc. Acad. Phila. 1884, p. 290) with the spikelets arranged in small dense clusters or little glomerules along the extremities of the branches of the very diffuse panicle. The spikelets were scarcely more than 2 mm. in length, with very narrow acuminate-pointed empty glumes.

19. (248.) DEYEUXIA LANGSDORFFII Kunth, Gram. I. 77, Enum. Pl. I. 243; Hooker Arc. Pl. 307 & 345; Coulter, Man. 413. *Calamagrostis Langsdorffii* Trin. Gram. Uni-Sesquifl. 225; Gray, Proc. Am. Acad, IV. 77, Manual, 615; Thurb. in S. Wats. Bot. Calif. II. 279. (To this species is referred *Deyeuxia purpurea* Kth., which name should, perhaps, take precedence.)—Common in wooded and open mountain meadaws and bogs, alt. 7000–9000 ft.

The specimens are exactly like the eastern plant with the awn attached considerably below the middle of glume which it equals or slightly exceeds. The leaves are much narrower than the ligule, which is 5–8 mm. long, more or less scabrous and remarkable for being strongly nerved.

20. (584.) DEYEUXIA CANADENSIS Hooker, Arc. Pl. 307 & 345; Coulter Man. 413. *Arundo Canadensis* Michx. Fl. I. 73. *Calamagrostis Canadensis* Beauv. (not Nutt.); Gray, Man. 615. *Calamagrostis Mexicana* Nutt. Gen. I. 46. (The C. Canadensis of Nuttall is Deyeuxia Nuttalliana.)—Common with the last.

The specimens represent a slender form with rather smaller spikelets than usual and more acute glumes. Flowering glume about 2.5 mm. long, deeply bifid and terminating in two very slender awn-like teeth. Awn attached at or a little above the middle. Palea scarcely half as long as its glume.

21. (585.) DEYEUXIA DUBIA, n. sp.—Empty glumes between 3 and 4 mm. long, lanceolate or oblong-lanceolate, either gradually tapering to the apex or abruptly acuminate, finely scabrous on the back above. Flowering glume nearly as long as the empty ones, bifid at the apex and irregularly 4-toothed by the prolongation of the prominent lateral nerves, minutely scabrous above the middle below which is attached the straight and rather stout awn that equals the outer glumes in length. Palea a *very little* shorter than its glume, distinctly 2-nerved, irregularly 2-toothed. Hairs on the rhachilla below the glume scanty and short behind, more abundant at the sides and $\frac{2}{3}$–$\frac{3}{4}$ the length of the glume.

A tall (60–90 cm.) grass with the foliage and habit of D. Canadensis or D. Langsdorffii, but differing from both in the less spreading and more densely flowered branches of the panicle, the stouter branches at each joint flower-bearing to the base. From D. Canadensis this species is at once distinguished by the longer and stouter awn, shorter hairs surrounding the flowering glume and firmer and longer palea. The spikelets are smaller than in D. Langsdorffii, the empty glumes are much smoother and less rigid or firm in texture, the hairs are less copious as well as shorter and the palea is proportionately longer.

Meadows, Slough Creek, alt. 6700 ft. (= no. 365 Scribner,

Montana collection. Found in open woods, Elk Creek, near Ft. Logan, alt. 5500 ft., July 25.)

21. (253, 582, 583.) DEYEUXIA NEGLECTA Kth. Gram. I. 76, Enum. Pl. I. 242. *Calamagrostis stricta* Beauv. (1812), Trin. Gram. Uni-Sesquifl. 226; Gray, Proc. Am. Acad. IV. 78; Thurb. in S. Wats. Bot. Calif. II. 282. *Deyeuxia stricta* Coulter, Man. 414 (not HBK.)

Dry meadows and slopes between 7000 and 9000 ft. altitude. So far as observed this species affects drier situations than the other species of the genus here named.

This species is distinguished by its rather rigid, erect and few (2, rarely 3) jointed stems, narrow rigid and usually erect leaves, strict and densely flowered panicle—often spike-like above, lobed and more or less interrupted below—the spikelets being crowded on short, usually appressed compound branches. The leaves of the sterile shoots are always very narrow and attain to one-half or two-thirds the height of the culm (their length is in marked contrast with the rather short leaves of the latter). No. 582 is a slender form (that may be designated as var. *gracilis*), 30–40 cm. high, with 3–4 stem leaves, the sheaths of which equal or much exceed the joints, and a narrow but rather loosely flowered panicle. The outer glumes are narrower and more pointed, less firm in texture and not so rough as in numbers 253 and 583. It is certainly of the same species, however.

Some of our specimens differ from the European plant in the more scabrous and firmer glumes, a difference that is by no means constant. *Calamagrostis confinis* Nutt. is too near this species to be kept distinct, and the same is probably true of *Calamagrostis crassiglumis* Thurb., which represents an opposed extreme in development. None of our forms of Deyeuxia neglecta exactly correspond with *Deyeuxia Lapponica* Kunth, from Europe. The differences, however, are slight and the two were united by Gen. Munro, the first name being made a synonym of the latter.

22. (616.) DESCHAMPSIA CÆSPITOSA Beauv., Agrost. 91, t. 18, f. 3; Coulter's Manual, p. 414. *Aira cæspitosa* L., Gray's Manual, p. 641. Dry and moist meadows and slopes, from 7000–9000 ft. altitude.

Although *D. cæspitosa* Beauv. and *D. flexuosa* Griseb. are at once recognized by one familiar with the two, the former is so variable, particularly in the Rocky Mountain forms, that it is not easy to find a constant character, which can be expressed, to distinguish them. It may be said, however, that in D. flexuosa the outer glumes are only 1-nerved (rarely the 2d is obscurely 3-nerved at the base) and much less firm in texture than the flowering ones. In D. cæspitosa the 2d (and sometimes also the

1st) glume is distinctly 3-nerved below, and the texture of the outer glumes is usually firmer than that of the flowering ones which are truncate at the apex and irregularly toothed, a character not observed in D. flexuosa. The awn in D. cæspitosa, usually about the length of the flowering glume, is sometimes quite as long as in D. flexuosa. I have never seen the latter species from the region west of the Mississippi.

23. (619.) TRISETUM SUBSPICATUM Beauv.; Coulter's Manual, p. 415.—Common in meadows from 7000–9000 ft. alt., low elevations preferring shaded or more moist situations.

24. (618.) TRISETUM SUBSPICATUM Beauv. var. MOLLE Gray. —Common with the preceding.

25. (249,250,617.) TRISETUM WOLFII Vasey in Bot. Wheeler's Exped. p. 294; Scribner, Torr. Bull. X, p. 64. *Trisetum subspicatum* P. B. var. *muticum* Bolander, ex Thurb. in S. Wats. Bot. Calif. II, p. 296 *Graphephorum Wolfii* Vasey in Descr. Cat. U. S. Grasses, 55; Coulter, Man. 433.—Moist meadows, generally in the shade, from 7500–9000 ft. alt., rather frequent. Associated with Deyeuxia Canadensis, Bromus ciliatus, etc.

The relationship of this grass to *Graphephorum melicoides* P. B., was indicated by Dr. Vasey in Wheeler's Report, and at that time he questioned whether it might not prove identical with that species, but more recent and better material has fully established its specific rank. It differs in having rather stouter and more rigid stems, a more densely flowered and erect panicle, more nearly equal outer glumes and in the comparatively longer paleæ. In later publications this species has been referred to the genus Graphephorum, but the only character—the very short or nearly obsolete awn—by which it has been seperated from Trisetum, is one of no generic value in itself. The fact that the flowering glumes are entire or merely obtusely two-lobed at the apex has no special significance as we not infrequently find the flowering glumes in T. subspicatum terminating similarly. The plant in question has in all respects—stem, leaves and inflorescence—the habit of T. subspicatum, and although a careful examination of the spikelets reveals its specific distinctions, it is not at all surprising that it should have been made a variety of that species. *Trisetum Brandegei* Scribn. (Torr. Bull. X, p. 64) is only a very robust form of T. Wolfii with 3–4 flowered spikelets.

26. (612.) AVENA STRIATA Michx.; Gray, Man. 640; Coulter, Man. 415. Wooded moist meadows and swamps, Slough creek, alt. 6800 ft., Soda Butte creek, alt. 7200 ft. Rather rare.

There is another Avena which may also occur within the park, as it is not infrequent in the mountain districts of central

Montana. It is distinguished from A. striata by its rigidly upright stems, strict, rather densely flowered, erect panicle, and larger spikelets. It is the Avena versicola of Hooker (Flor. Bor.-Am.), but certainly not of Villars. It equals no. 372 Scribner, Montana collection, distributed in 1884, under the name of *Avena pratensis* L. var. *Americana*.

Specimens of this grass were communicated to Prof. E. Hackel, of Austria, who states in a letter dated June 27, 1884, that it is a species he had long known, having first received it from European Russia and later from the Ural Mts. and also from the mountains of Altau and Dauria, in Northern Asia. He adds that he did not publish the species because he was uncertain of its specific distinction from *A. pratensis* L. and *A. compressa* Heuff., but at that time he considered it "quite as distinct as most of the species of the group of pratensis, which is a very perplexing one and can only be treated monographically."

27. (269, 597.) DANTHONIA INTERMEDIA Vasey in Torr. Bull., May, 1883.—Dry and moist meadows, from 7500 to 8500 ft. alt., rather common.

This grass is referred to *D. sericea* Nutt. by Dr. Thurber (S. Wats. Bot. Calif. II. 294), and Prof. Coulter follows him (Man. Rocky Mt. Botany, p. 416), but it is sufficiently distinct from Nuttall's plant and is undoubtedly a good species. Stem and leaves as in *D. sericea* Nutt., but not usually so tall, being rarely over 50 cm. high; the 1–3-flowered branches of the usually shorter (3–5 cm.) panicle, more appressed, and consequently the spikelets are more crowded; the outer glumes are about the same length as those in D. sericea (13–16 mm.) but they are fully *twice as broad* and have a different venation, while the flowering glumes are fully twice as large and perfectly smooth excepting along the margins below, as in D. Californica, but there are abundant differences separating it from that species.

In central Montana this grass occurs most frequently associated with Festuca scabrella at from 6000–8000 ft. alt.

28. (596.) DANTHONIA CALIFORNICA Boland. var. UNISPICATA Thurb. in S. Wats. Bot. Calif. II, p. 294; Coulter, Man. 415. *D. unispicata* Munro in Herb. *D. monostachya* Nutt. in Herb. Phila. Acad.—Dry rocky open places, Slough creek, rare.

29. (260.) KŒLERIA CRISTATA Pers.; Coulter, Man. 418. —Common everywhere in dry situations up to alt. 8000 ft. For notes upon this species see Scribner in Proc. Kansas Acad. Science, p. 117, plate III.

30. (577.) CATABROSA AQUATICA P. B.; Coulter, Man. 419. —In water, Gardener's river, alt. 5400 ft. Not seen elsewhere.

31. (268, 601, 602.) MELICA SPECTABILE Scribn. Proc. Acad. Nat. Sci. Phila. 1885, p. 45, plate I. f. 11, 12, 13.—Common in rich meadows and on slopes near the upper limits of the bunch grass areas especially at elevations of from 7000–8000 ft.

The difference in habit of growth between *Melica bulbosa* Geyer, and *M. spectabile* Scribner are thus stated by Mr. Cusick: "M. bulbosa grows in small tufts while M. spectabile is stoloniferous, the underground runners terminated by a small bulb which produces the culm. The runner, I think, soon dies and so the stems become independent, and are never cespitose in the least."

Outline for study of Chemical Botany.

LILLIE J. MARTIN.

Botanical text-books do not furnish sufficient aid to those desiring to learn to make investigations in vegetable physiology. Students with but a general knowledge of chemistry do not understand the bearing of the microchemical tests given. The result is, that most of the work is mechanical. In fact, any really satisfactory course in chemical botany must be introduced by a short course in organic chemistry. The student who has found out the nature and quantity of the more important constituents of a plant is prepared to trace these substances in its various tissues and even to observe the chemical changes that take place in the process of growth. The outline below, mainly drawn from that proposed by Dragendorff, is an attempt to put this idea into form for class work. No particular plant is suggested, because no one greatly superior to all others yet suggests itself. Corn smut is so rich in products and so easily prepared that at first thought it seemed particularly adapted to such work, but a superficial examination showed that it required too high a power of the microscope to be of value for the microscopical work. Possibly the histological work previously done upon the asparagus and pumpkin vine might make it desirable to use one of these plants.

I. Weigh out five grams of the pulverized plant, burn off organic matter and determine per cent. ash. Make a qualitative examination of half the ash by the method of inorganic chemistry. In the other half determine the amount of some one of the constituents found. Examine ash with microscope to learn if there is anything of a structural nature about it.

II. Weigh out five grams more. Dry at 100° C. until it ceases

to lose weight. Calculate per cent. moisture. Put in a glass-stoppered bottle, add 10^{cc} petroleum spirit for every gram substance left. Macerate for a week or so, shaking several times each day. Filter.

<table>
<tr><td>A Filtrate:—
a. Evaporate an aliquot part to dryness and compute total solid.
b. Make a superficial examination of fixed oil and determine amount.
c. Ethereal oil should be looked for.
d. Use solutions of different strengths and by means of the spectroscope identify the chlorophyll by its spectrum.

A′ Compare sections of the plant before and after treatment with petroleum. Note of the substances named above and observe change in the plant by use of the solvent. Record the observations by drawings.</td><td colspan="6">B. Residue:—Dry at ordinary temperature and treat with ether as with petroleum spirit.

C. Filtrate
a. Determine total solid.
b. Make a superficial examination of the resins.

C′. Examine as in A′.</td><td colspan="5">D. Residue:—Dry at ordinary temperature and treat with absolute alcohol as with petroleum spirit.

E. Filtrate
a. Determine total solid.
b. Make tests for
1. Tannins
2. Alkaloids
3. Glucoses

E′. Examine under microscope as in A′.</td><td colspan="4">F. Residue:—Treat with water.

G. Filtrate:—
a. Examine
1. Mucilage
2. Inulin
b. Test for
1. Malic
2. Tartaric
3. Oxalic and other acids.
c. Make distinguishing tests for saccharose and glucose and estimate glucose volumetrically by Fehling's solution.

G′. As in A′.</td><td colspan="3">H. Residue:—Treat with dilute soda.

I. Filtrate:
a. Examine albuminoids with care.

I′. Under microsc'pe as in A′.</td><td colspan="2">J. Residue:—Treat with hydrochloric acid

K. Filtrate
a. Qualitative and quantitative examination of starch.

K′. Under microsc'pe as in A′.</td><td>L. Residue
a. Look for lignin and its allies.
b. For cellulose.

L′ As in A′.</td></tr>
</table>

Professor Goodale classifies organic substances as follows:

A. Products free from nitrogen:—

I. Carbohydrates
- 1. The cellulose group. ..... (1) Cellulose; (2) Starch; (3) Inulin; (4) Dextrin; (5) Lichenin
- 2. The sugar group.. 1. Grape sugar. 2. Fruit " 3. Cane " (6) Gums; (7) Dextrin; (8) Pectin bodies

II. Vegetable acids
- (1) Oxalic
- (2) Tartaric
- (3) Citric
- (4) Malic.

III. Fats or Glycerides. IV. Certain astringents. Tannins. V. Glucosides. VI. Resins. VII. Ethereal oils.

B. Products containing nitrogen:—

I. Albumin-like matter. II. Asparagin. III. Alkaloids. IV. Unorganized ferments.

Inorganic substances are there classified in "How Plants Grow":

Bases.
- Potash.
- Soda.
- Lime.
- Magnesia.
- Oxide of Iron.

Acids.
- Chlorine.
- Sulphuric.
- Phosphoric.
- Silicic.
- Carbonic.

Most of the substances named above are found in the analytical scheme proposed and by going through the work the student really becomes acquainted with them. If a typical plant is selected he may even learn the quantity in which some of the more important constituents occur. Something in the way of comparison is even possible. Different members of the class may take different parts of the plant at the same age or the same part at different ages and compare them as to amount of ash, water or some other constituent. Sach's discovery that "squash seeds, which, when ripe, contain no starch, sugar or dextrine, but are very rich in oil (50%), and albuminoids (40%), suffer by germination such chemical change that the oil rapidly diminishes in quantity, while at the same time starch, and in some cases sugar, is formed," suggests a great variety of more elaborate and by no means impracticable lines of comparative study on the part of botanical students. So much for micro-chemical comparisons. Micro-chemical comparisons as to the physical condition and position of the various substances in the specimens upon which the students are working will of course be made.

Even if desirable in itself two objections will be made to the course proposed—time required for the work outlined and its expense. It is thought that the large number of solvents used and the fact that they can be employed cold and that the drying and evaporating can be done at ordinary temperature will greatly facilitate matters. Of course some pieces of apparatus must be purchased, such as a good balance, polariscope and spectroscope that can be attached to the microscope, platinum dish, Liebig's condenser for getting distilled water, chemical thermometer, burrette, porcelain evaporating dish and glass stoppered bottle for each student, and test tubes, but tripods, forceps, alcohol lamps, desiccater, drying oven, etc., can be made by the students. The main reagents will be needed in some quantity, but one set of reagent bottles will hold the other substances needed.

BRIEFER ARTICLES.

Calochortus Obispoensis, n. sp.—Corm fibrous-coated, deep seated, one-half to one inch thick: stem simple or branched, one to two feet high, flexuous, leafy, often bulbiferous below: upper leaves reduced to subulate bracts, all convolute and long attenuate: flowers solitary or numerous; peduncles one to two inches long: sepals about an inch long, rotate-spreading, lanceolate, acuminate, soon convolute, veined within with brown: petals one-half to two-thirds as long, rotate or recurved in anthesis, oblong, truncate, often bifid and the lobes con-

nivent backwards, lemon yellow becoming orange at base, brownish-red above beset more or less throughout with long hairs (3–4 lines), the lower yellow or deep orange, the upper dark reddish brown; gland round-elliptical, naked but enclosed by a fimbriate ring of long, erect, converging, orange colored hairs: anthers light snuff-color, obtuse, two or three lines long: capsules narrowly oblong with thick, obtuse angles.

This peculiar Mariposa stands near C. Weedii and C. clavatus, resembling the former in its corm, leaves, etc., and the latter in its markings, pubescence, etc., but it is abundantly distinguished by its short, comparatively narrow, often bifid petals, etc.

On dry, stony hills near San Luis Obispo, Cal., on the premises of Dr. W. W. Hays, May 25, 1886. Collected in 1882 further eastward by Miss Georgie Hays, Miss Dalidet, Mrs. R. W. Summers and others.—J. G. LEMMON.

A rare fern.—Mr. John Spence, of Santa Barbara, recently discovered a rare fern in the high mountain regions of Santa Barbara county, which appears to be a South American Notholæna, *N. tenera* Gill., not heretofore reported in the United States except in a single locality in Southern Utah. In form and manner of growth it resembles *Notholæna nivea* Desv. (See Hooker & Baker's "Synopsis Filicum" p. 374.) As N. nivea is placed under the subdivision Cincinalis, characterized by the fronds being coated with white or yellow powder, and these specimens show no trace of such powder, they must be placed under the subdivision Eunothochlæna, in which the fronds are not farinose beneath, and under the specific name given above, a fern found in the Andes of Bolivia and Chili, which the best authorities (see Sir J. W. Hooker's Species Filicum, vol. 5. p. 112) state is a very doubtfully distinct species from *N. nivea*, from which it differs only in the absence of the powder beneath.

Prof. D. C. Eaton in his "Ferns of North America" figures N. tenera found in Southern Utah, but the plate is too poor to give a correct idea of the species, and the author expresses a doubt as to the correctness of the determination.

On comparing Mr. Spence's specimen with a specimen of N. nivea in my collection (also a South American species, not reported in the United States until found by Prof. Lemmon in Arizona in 1883), I find the resemblance complete, except that the Californian specimen shows no trace of powder on the under side of the frond, which corresponds with the N. tenera of H. & B. The pinnæ being less distant may be the result of climatic differences.

In the absence of further evidence Mr. Spence's discovery may, with reasonable certainty, be called Notholæna tenera.

Mr. Spence also found a rare form of Aspidium munitum in the same locality.—LORENZO G. YATES, *Santa Barbara, Calif.*

William S. Clark, Ph. D.—William Smith Clark, the well-known botanist and educator of Massachusetts, died at his home in Amherst, Mass., March 9th, 1886.

He was the son of Dr. Atherton Clark, and was born in Ashfield, Mass., July 31, 1826. He fitted for college at Williston Seminary, East Hampton, Mass., and entered Amherst College in 1844, graduating with the title of A. B., 1848. For two years after graduating he taught the natural sciences in Willis-

ton Seminary. He then went to Europe, entered the Göttingen University, Germany, and received his diplomas of A. M. and Ph. D. with Prof. C. A. Goessmann, the noted organic chemist and director of the Massachusetts Experiment Station.

Upon his return from Germany he was elected to the chair of chemistry and botany in Amherst College, which he retained until August, 1867, when he was elected president of the Massachusetts Agricultural College. He took active part in the rebellion with the Twenty-first Massachusetts regiment as its colonel.

Colonel Clark was noted for the energy and enthusiasm he put into everything he undertook, and in the class-room he imparted this to his students to such an extent that very thorough and rapid progress was always made. During the last fifteen or twenty years of his life he made the study of plant-life his specialty, and conducted a series of very careful experiments upon the circulation of sap in plants, the expansive force of plant tissues, the movements of plants, rapidity of the movements of sap, etc., most of which are recorded in the catalogues of the Massachusetts Agricultural College and the annual reports of the secretary of the Massachusetts Board of Agriculture.

These papers, which are valuable additions to botanical literature, are perhaps his most important writings, although he was always ready with lectures upon almost all industrial and natural scientific subjects whenever called upon and was a most brilliant and fascinating speaker. In 1876 he was granted a leave of absence and established the Royal Agricultural College at Sapporo, Japan.

His many pupils look back with pleasure to the profitable days spent under his instruction, in which they always found him a true friend and wise counselor. S. T. MAYNARD.

Tuckerman bibliography.—The following correction and additions may be made to the list on page 74 of this volume.

Notice of some Cyperaceæ of our vicinity : Hovey's *Mag. of Hort. and Bot.* vii. 208–210 (1841).

Descriptions of several new plants of New England : *ibid*, ix. 142–3 (1843).

Carex argyrantha *sp. nov.* : distrib. with descr. Amherst, Aug. 16, 1859; published in Wood's *Class-Book of Botany* 1861, p. 753.

Carex glaucodea *Mss.* : *Proc. Am. Acad.* vii. 395 (1868).

Lichens or fungi ? : *Bull. Torr. Bot. Club*, vii. 66–7 (1881).

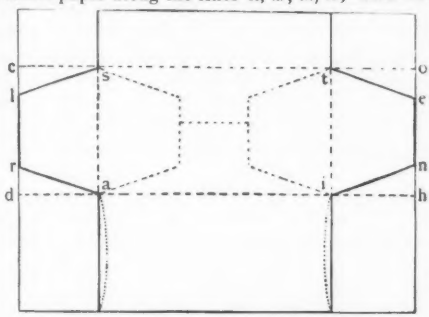
Review of Minks's Symbolæ Licheno-Mycologicæ : *ibid.* ix. 143 (1882).

The Synopsis of the Lichens of the Northern U. S., etc., was first published in *Proc. Am. Acad.* i. 195–285 (1848).—HENRY WILLEY.

Vancouveria.—In the two most recent fascicles of the Bulletin of the Botanical Society of France, M. Franchet has published an elaborate review and monograph of the genus Epimedium. Adopting Baillon's idea, he refers back to it the Pacific-coast genus Vancouveria of Decaisne, which, M. Franchet insists, differs in nothing but the ternary instead of the binary plan of the blossom. For it seems that some common species of Epimedium occasionally produce petals which are not saccate or spurred (which certainly *militates*

against Aceranthus), and in one the perianth is in a manner reflexed. But both Baillon and Franchet leave out of view a marked character of Vancouveria, namely, the unguiculate petals. In Vancouveria each petal consists of a long ligulate portion or claw, bearing at its summit an inflexed and bordered lamina, which is the homologue of the always sessile or basal sac of Epimedium. We recognize three forms or varieties of V. hexandra but can not make out more than one species.—A. GRAY.

To make pockets.—Fold a rectangular piece of paper of desired size along the line *dh* and again along *eo;* bend the folded paper over a sharp edge (e. g. a tin paper-cutter) so as to mark the points *t, i, s, a;* with scissors cut the folded paper along the lines *sl, ar, in, te;* with knife or paper-cutter cut away the two upper layers of the folded paper along the lines *ti, as,* so as to leave the sheet when unfolded of the shape shown by the heavier outline. When folded into a pocket the appearance is indicated by the broken lines within *asti.* If the objects to be enclosed are large the lower flap must be cut away as shown by dotted line. These pockets are quickly made after a little practice and are indispensable for fruits, seeds, flowers and smaller specimens. Directions for making a simpler, equally effective but less convenient kind will be found in the June number, p. 142.



POCKET FOR HERBARIUM.

A botanical diary.—While gathering specimens for preservation in an herbarium, and future study, some device for recording and ready reference to them is very desirable. After trying various plans, the following form of diary was devised, and has worked so well for the fifteen years of trial, that it has become a permanent thing in the economy of the writer.

A plain blank book, of a size suitable for carrying in the pocket, is obtained. It may serve for one year, or several, according to the amount of work done, and entries made. The plants gathered and studied are numbered from 1 to the last entry for the year. At the beginning of each year of work a new numbering is commenced, the year, as a date, heading the list. Two or three lines may serve for entry, unless peculiarities are recorded. If more space is expected to be needed than is used at the time of making an entry, a page or more may be left blank for future use, or whatever is thought necessary. To illustrate, taking some cases at random from the list of 1878:

"2. Weisia viridula. On the ground in meadows, Englewood, Ill., Mar. 16, Apr. 13."

"11. Draba Caroliniana. Sandy grounds, Englewood, Apr. 13. No. 2. Petals wanting on the later racemes." (This implies that two kinds of specimens were gathered, the second being marked "11, No. 2.")

"198. Dicranum congestum. High sandy hills; Boyne Falls, July 30. (Hills southeast of the village, 325 feet above Lake Michigan.) On the ground; loosely cæspitose."

Boyne Falls is in Michigan, and Mich. is placed after the name in connection with the first plant collected there.

At the time of placing a plant in the drying papers a card is put with it, corresponding to the number in the note book as "198. 78. Dicranum congestum." The latter number gives the year. This card is kept with the specimen till mounted. When mounted, by turning to the corresponding number in the diary, any particulars needed for the label may be found. When a plant is dried for the herbarium an entry is also made on the margin of the page of the botany used in identifying, using the last two numbers of the year in which it is collected. Opening my copy of Gray's Manual to Hippuris vulgaris, on the margin are found three numbers, "78, 80, 83." If any information is wanted this becomes an index to show where the information may be found. It saves much time to look it up here instead of in the cabinet, if the specimen itself is not needed. The number on the margin serves also as a record or check list of plants, so that it may not be repeatedly gathered, unless special reasons exist for it.

Note books kept in this way become very useful in the study of geographical distribution. It is an exact record, easy of access. The system is a kind of botanical book keeping, as useful and accurate in its way as that of the accountant.—E. J. HILL.

Collecting Fossil Plants.—Fossil plants are to be looked for in the shale above the coal veins, and sometimes in the stigmaria clay below. In the subconglomerate coal measures of Arkansas the impressions occur in the shale within 18 inches of the coal. The best are found from 8 to 18 inches above. But few forms are found above 12 inches. Close to the coal is a layer of fragile shale a few inches thick, filled with indeterminable fragments, but sometimes yielding species not found in the firmer rock above. The impressions near the coal are never good, being nearly the color of the shale and much broken. To get the entire range of species it is best to examine all the shale from the coal to the barren rock above, at as many localities as possible. Carboniferous plants grow in clumps as they do in our modern swamps, and were often local. Species collected once at a locality may never be found again, and suddenly a dozen new ones may appear. Always save poor specimens of new or doubtful forms, but discard the small fragments of well-known and common species. Reverses, unless large and fine, are worthless. Break open any nodules found, as they often contain plant remains. Keep all the parts of an impression together when broken, as they may be mended by cement, or set in position in a plaster of Paris base. Better leave considerable shale with a good impression than run the risk of breaking it by trimming.

In shaping, a meat saw can be used to good advantage on fragile shales free from nodules. A pair of pincers is useful, also a wooden clamp to prevent forcing while trimming with a hammer. Shale from the coal measures of Arkansas, if dried either in the sun or shade without being exposed to rain, will

not crumble, and will become firmer by drying. Shales containing iron pyrites are liable to crumble from oxidation.

Shales work easier when first taken out, as they are wet, but are more liable to crumble in splitting. While drying out lines of cleavage are developed, showing where to put the chisel to expose the best impressions. Promising shale can be stored away in a dry place and worked over at leisure. Different species occur in the shale at different levels, and experience soon teaches one how to work the shale for particular forms.

For collecting fossils, one needs a crow-bar, shovel or spade, pickaxe, and blasting material, if he is searching at a locality not worked. If at a mine in operation the above tools, if needed, can generally be borrowed from the miners. Several steel chisels from ½ to 1 inch wide and 8 inches long, and as thin as possible, are necessary, also one heavy and one light hammer. In splitting small shales a strong butcher knife and a light hammer have been used to good purpose. In opening large shales to expose surfaces it is best to insert several chisels along the supposed line of fracture and work continuously. The impressions should never be touched with the fingers as they are easily dimmed. Cigar boxes for small specimens and fragile pieces, and larger boxes for heavier shales are necessary. All specimens should be wrapped in paper and tightly packed on edge, and all the interstices filled with paper, sawdust, leaves or any available packing material.

Essential requisites in forming a cabinet of fossil plants are patience and perseverance on the part of the collector. He must be content to split shale all day in the hot sun or bitter cold, and often go home with empty boxes. Specimens in the cabinet should be laid flat in drawers, such as are used for minerals, or in show cases, if designed for exhibition. They are necessarily fragmentary, and a number of specimens of each form is desirable. The specimens must be numbered, to correspond with those of a record book, in which all data are given. A card placed with each specimen states where it is figured and described, and the front of the drawer is labeled with the contained genus and species. The color of the label can be made to indicate the group, as blue for ferns, etc. The specimens should never be wet, oiled, or varnished.—F. L. HARVEY.

The directions which Prof. Harvey gives for collecting in carboniferous strata apply in the main to all formations.

Drying plants out of doors in wet weather.—For 30 years I have collected plants in both wet and dry climates and of necessity have tried many plans. At present I have, I think, a perfect system and as it is all original I will give it in full. I have tried all other plans and none meets every case but my own. When out collecting I gather flowering plants in dry weather, and lichens, mosses and liverworts wet, especially lichens. My driers are either newspapers or the usual ones advertised in the GAZETTE. I collect cryptogams in a basket, and afterwards sort them and place them in flattened pieces or tufts on single sheets of paper of a slightly smaller size than the driers. I fill each sheet, taking no account of species, and place on it a slip with the date. I place each sheet between driers and when all are assorted I place the pile between boards and put on the pressure with leather straps.

Next morning when the sun gets hot I, or my man, take the parcel to an open and level place, spread out a water-proof sheet black side up and carefully taking off each sheet of specimens slide it into position on the waterproof, one of which will hold twenty-four sheets of specimens. I put small stones and sticks on the corners and so leave them exposed to the sun. In a very short time they are dry and at once packed away. In the winter I assort them. This plan *in part* I have practiced since 1875, when in northern British Columbia where the weather was so wet that we had rain every day during the month of June.

My plan for phænogams and mosses was only perfected last year, and for phænogams would be of no use without the thick and heavy driers. For the past four years I have been in the habit of placing my sheets of specimens when partly dry on a level surface of dry rock, earth or sand, and then exposing them covered with a single drier to the sun. This worked well in dry weather, but when everything was wet we could do nothing. Last June I was collecting in the Rockies and had showers four or five times a day, so that I could get no dry places for my plants. I had two wire presses, but they were too full, and the air was almost at the point of saturation. One day I spread out my plants in my old way and a thunder storm coming up I hastily covered them with my waterproof sheets. Five minutes after the rain cleared off the waterproof was dry. I now changed my tactics and put the waterproof beneath and I had beaten both weather and locality.

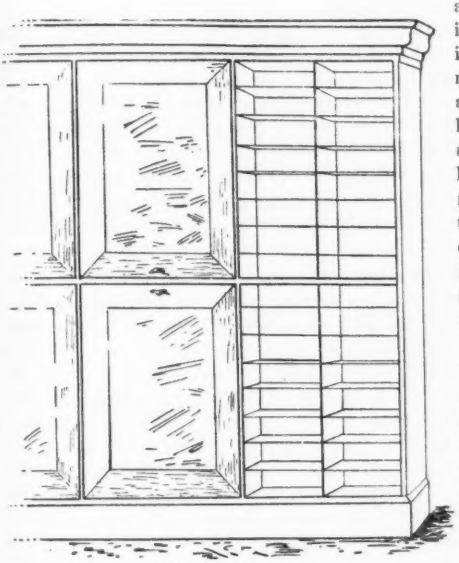
My plan for phænogams in full is this: I carry my driers and half sheets always with me when collecting. My whole outfit is a knife, a basket and a portfolio or press made of two boards of three-ply veneers with straps to fasten them together. I gather my specimens and place them on the half sheets while they are quite fresh, in fact they are put in the press as soon as collected. I keep the collection of each day by itself. Every morning before leaving camp I go over all the specimens *exposed* the day before and label and put away the dry ones, while the others are again exposed.

No matter how wet the weather may be, if I can get three hours' sunshine I can dry my plants without any difficulty. I usually keep my plants one day in the press before exposing them, as I find if they have not had time to wilt they curl in drying.

Let the ground be wet or dry I clear off a space for one or two waterproofs and lay them down with the black side up. As soon as they are warm I unstrap my press, taking a half sheet and drier (drier on top) and place them on the waterproof in rows. Each one holds about twenty-four. I now lay small sticks or stones on the margins or corners and leave them for three or four hours. They are again taken up and put in press until the next morning, when the dry ones are labeled and put away, while the others are again exposed.

By the methods given above I dried over 1,500 sheets last year in a wet region and all my specimens kept their color, although for weeks together it rained every day.—JOHN MACOUN.

Herbarium cases.—I make my cases low enough so that one can easily reach the uppermost specimens without leaving the floor. The pigeon-holes

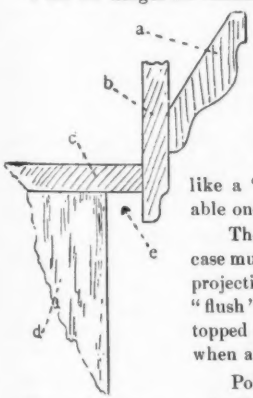


HERBARIUM CASE.

are 12½ inches wide, 4 inches high, and 17 to 18 inches deep; all inside measurements. They are arranged in two series, a lower and an upper, *which are equal.* The lower series begins at from 7 to 8 inches above the floor, and contains eight pigeon-holes; then I have a heavy cross-bar or partition, and above this is the second series.

The doors to my cases are removable, and are of *equal size.* The lower doors cover the lower series of pigeon-holes, and the upper doors cover the upper series. Each door is a little more than two feet wide, and so covers two rows of pigeon-holes.

I use no hinges for fastening the doors. They are made as follows: The lower end of each lower door fits into a groove in the case, and the upper end is held in place by a simple button. The upper end of each upper door fits into a groove in the case, and its lower end is held by a button. The edges of the doors are properly rabbetted, so as to make them approximately dust proof. A little handle like a "drawer-pull," is attached to each door to enable one to draw it out.



SECTION OF CORNICE.

a, cornice molding; *b*, door guard; *c*, top of case; *d*, side of case; *e*, groove which receives top of door.

These moveable doors render the work about a large case much more agreeable, as one is not bothered by the projecting doors. I lay these doors (which are paneled "flush" on the inside) on light trestles, or even on flat-topped chairs, and so make a great amount of table room when at work in the herba-rium.—CHAS. E. BESSEY.

Poisoning and repoisoning specimens is a necessity in the herbarium, but with the greatest care insect pests manage to get a foothold somewhere or other every year. It is a mistake to suppose that the most careful poisoning will prevent their ravages. While

I believe in the liberal use of poison, I have long been convinced that it is hopeless to try and prevent the ingress of insects by this means alone, and shall model my herbarium cases after the new ones devoted to Compositæ in the Gray Herbarium, described in the June number. Such a case is as nearly dust-proof as can be expected, and is tight enough so that a cup of chloroform, set on one of the shelves occasionally, will destroy any insects that may be at work. A suggestion of Prof. Brewer to concave the fronts of the shelves *near the right-hand end*, for lifting out the sheets, and to have the shelves one inch shorter than the sheet, at the back, to allow dust to fall to the bottom, obviating the necessity of brushing out each shelf, is worth acting upon.—WILLIAM TRELEASE.

Corydalis aurea and its allies.—In former years Dr. Engelmann studied this group attentively, and gave me various notes and sketches; but hardly anything has been published except the few memoranda which I incorporated into the Manual. A careful study of the group now made has on the whole confirmed Dr. Englemann's views, but has led to the admission of one species, which he had concluded to be a mere state of C. aurea. It will be seen from the following notes that some points remain upon which further information is needed.

The species are conveniently arranged in two groups, as follows:

1. Hood or saccate tip of outer petals crestless, the back at most carinate: flowers golden yellow.

C. AUREA Willd. Commonly spreading and with slender pedicels: spur of corolla barely half the length of the body, somewhat decurved: capsules pendulous or spreading, terete, torulose when dry: seeds turgid, obtuse at margin, the shining surface obscurely reticulated under a lens.

Extends from Lower Canada to British Columbia and Oregon, north to lat 64°, southwestward to Texas, Arizona, and into adjacent parts of Mexico. But *not* into N. E. Asia or Japan. The plant of the Rocky Mountains and westward commonly has longer spurs. Only southward do we find the marked form which Dr. Englemann was naturally disposed to separate as a species, but at length agreed to call

Var. OCCIDENTALIS Engelm. in Gray Man. 62. More erect and cespitose, stouter, often with thickened root which Engelmann took to be "subperennial," but probably, like the species, only biennial: flowers rather larger and in a stouter erect raceme, with spur almost as long as the body and commonly ascending: capsules thicker, less torulose, mostly incurved-ascending on short spreading pedicels: seeds less turgid and margins acutish.—*C. montana* Engelm. l. c. and Wood, Bot. 34.

Fendler's New Mexican plant was chiefly the original of this: but it is better represented by C. Wright's no. 1309 from near El Paso, by specimens which I myself collected there in the early spring of 1885, by Pringle's no. 198 of the same year from Chihuahua, by specimens collected in Arizona by Palmer in 1865, by Rusby in New Mexico, and by Hall & Harbour's no. 31 from Colorado, which has been referred to C. curvisiliqua. These all approach that species; but the pods seem to be terete, are shorter, and the seeds have the slight markings of those of C. aurea.

C. CURVISILIQUA Engelm. l. c. Habit of the preceding variety, and with spiciform raceme of rather larger flowers (over half inch long), the spur as long

as the body: capsules *quadrangular* (inch and a half long, 2 lines thick), incurved and ascending or straightish on very short and stout diverging pedicels: seeds turgid-lenticular, with acute margins and minutely muriculate surface.

The only certain specimens I possess are those of Lindheimer's Texan collection, collected near New Braunfels in 1850 and 1851. Mrs. Bittle once showed me a fine drawing from the living plant, showing the perfectly tetragonal pods. Specimens from W. Texas, without fruit, which may belong here, were collected by Berlandier, Wright, and Girard. It is commended to the attention of Texan botanists.

2. Hood or saccate tip of outer petals (except in cleistogamous flowers) dorsally wing-crested.

*Flowers bright yellow, about two-thirds of an inch long: stem mostly erect.

C. CRYSTALLINA Engelm. l. c. Habit of the preceding: flowers spicate, with spur nearly as long as the body; dorsal crest short, very wide and salient, 3 to 4-toothed: capsules linear-oblong, terete, half or three-fourths inch long, erect on very short pedicels, pruinose when fresh with transparent vesicles (such as beset the leaves of Mesembrianthemum crystallinum): seeds acute-margined, the coat minutely tubercular-reticulated.

Prairies and fields of Arkansas and S. W. Missouri. Excellent specimens of this, collected by Prof. F. L. Harvey, in Curtiss's distribution.

**Flowers pale yellow, short-spurred, only a quarter or third of an inch in length: stems diffuse and slender: capsules linear and slender, torulose.

C. FLAVULA DC. Flowers conspicuously bracted and slender-pedicelled: outer petals surpassing the inner; crest very salient, 3 to 4-toothed: capsules pendulous: seeds acutely margined, rugose-reticulated, at least toward the margins.—*C. flavidula* Chapman, Fl. ed. 2, 604, a slip of the pen.

Lake Erie to Virginia, Tennessee, Missouri and Louisiana.

C. MICRANTHA. Flowers short-pedicelled and small-bracted, when full-developed a third of an inch long, narrow, with spur a line or two long, and with rather narrow lunate and entire crests; often with only cleistogamous and much smaller flowers, which are spurless and crestless or only slightly crested: capsules ascending on short or very short pedicels: seeds turgid, obtuse at margin, shining, as in typical C. aurea.—*C. aurea*, var. *micrantha* Engelm. in Gray, Man. l. c., only cleistogamous flowers known. *C. aurea*, var. *australis* Chapm. Fl. ed. 2, 604, who had only the normal flowers.

Texas to Missouri and Florida, and at Cape Fear, N. Carolina, *Havard*, whose specimens show earlier normal and later cleistogamous flowers on same individuals. On the Atlantic coast, from N. Carolina to Louisiana (where the normal form was collected by M. Langlois) this appears to be the only species. In Missouri it is said to grow intermixed with C. aurea. Confirmation of this is desirable.—ASA GRAY.

Development of Rœsteliæ from Gymnosporangia.—The culture of spores of the *Gymnosporangia* of this country upon different *Pomeæ*, which I have undertaken for several years, has been continued this year by Mr. Roland Thaxter in the Cryptogamic laboratory at Harvard. In my own cultures spermagonia only were produced on the different hosts, but Mr. Thaxter has been more successful, and has been able to produce the æcidia in several cases. His cultures are not yet completed, but I should like to call attention to some

of the results reached, leaving details for Mr. Thaxter's paper on the subject, which will soon appear in print.

The spores of *Gym. clavipes* C. & P. growing on stems of Juniperus Virginiana were sown on young plants of Amelanchier Canadensis and were followed by a luxuriant growth of *Roestelia aurantiaca* Peck. *Gym. clavipes* was detected for the first time on Juniperus communis at Weymouth, Mass., by Mr. J. F. Humphrey, and was afterwards found on the same host in another locality by Mr. Thaxter. Cultures were also made of the foliicolous *Gymnosporangium*, which causes the well known bird-nest distortion of J. Virginiana, which is stated in my paper on "Gymnosporangia of the United States" to be a form of *G. clavipes*. The shape of the spores and their pedicels, and the fact that they sometimes germinate at both ends as in *G. clavipes*, lead me to refer the bird-nest form to that species. This view is incorrect, and the bird-nest form is rather to be referred to *G. conicum* DC., and the cultures made by Mr. Thaxter developed the æcidia of *Roestelia cornuta* Fr. on Amelanchier, thus agreeing with Oersted's experiments. The spores of *Gym. clavariæforme* DC. on J. communis sown on *Cratægus tomentosa* were followed by *Roestelia lacerata* Fr., also agreeing with Oersted's experiments. The cultures of spores of other species of *Gymnosporangium* are still under way and have given some interesting results already, but a full statement will appear later in Mr. Thaxter's paper.—W. G. FARLOW.

The Arillus in Asimina was described by me and figured from Sprague's drawings in the Genera Illustrata. Some botanist, I think M. Baillon, has controverted the statement, taking the view that the so-called arillus was only a false membrane, a condensation of the pulp of the pericarp around the seeds. Fresh fruits of A. grandiflora and A. pygmæa, communicated by Mr. Curtiss from Florida, clearly show the distinct and rather firm membrane, investing the seed and firmly attached at the hilum. I have not been able to study its formation and growth, which is still needful.—A. GRAY.

Gymnosporangium macropus on Pirus coronaria.—The "cedar apples" were gathered from several small trees of Juniperus Virginiana on April 12th, and before any of the gelatinous masses or "horns" upon the excrescences had made their appearance. The "apples" were placed in water on a plate in the laboratory until the spores had germinated and produced their sporidia in great abundance. On April 23d, sowings of the sporids were made upon the young leaves of the wild crab apple (Pirus coronaria).

The leaves and tips of branches sown were at once covered with sacs of cloth similar to those used in crossing and hybridizing plants. The same number of sacs were placed upon tips of twigs on which no Gymnosporangium spores had been sown.

By the method of forcing the growth of the cedar apples by keeping them moist and in a warm room, the danger of a previous inoculation of the leaves sown was avoided.

On May 12th spermagonia were found in abundance in process of formation upon the leaves in every instance where sowings had been made. On the other hand, not a sign of a fungus was observed on the unsown leaves under the sacs or on any other parts of the trees. The success of the inoculation was

so complete that the leaves receiving the sporids were on May 17th almost entirely orange-colored and the affected twigs could be distinguished several feet away.

On May 17th a second series of sowings under sacs was made. Two weeks later all of these latter had developed the fungus, while the leaves of the first sowing were becoming covered with dark dots, indicating the maturity of the spermagonia. After making the second sowings under sacs a quantity of the Gymnosporangium sporidia was scattered over the leaves of certain branches and left uncovered. At the time of writing these branches are easily distinguished by the prevailing orange-color of their affected leaves. The natural sowings are now beginning to develop as small orange spots, but they as yet are few in number and behind those from the artificial sowings. In case of the inoculations that have been made through the agency of the wind the spots are small, circular, and appear as the growth of one spore; while in the artificial sowings the blotches are very irregular and far more vigorous. The leaves first inoculated are now thickening in patches, preparatory to the formation of the rœstelia state of the fungus. It remains to determine the species of the rœstelia and carry the spores back to the cedar and determine if they will produce the teleutospores of the fungus direct, or whether a uredo state is necessary to complete the cycle of forms in this polymorphic fungus.

Sowings have been made upon the cultivated apple and other species of Pirus, as well as upon the genus Cratægus, but these results are less pronounced and not ready to be set down.—Byron D. Halsted, *Iowa Agricultural College, June 15.*

EDITORIAL.

The *Popular Science Monthly* for June contains a portrait and biographical sketch of the late Dr. George Engelmann. The author is anonymous, but can hardly have been a botanist or he would not be so ignorant of the true authorship of the classic "*Plantæ Fendlerianæ*" as to say—

"In 1849 Dr. Engelmann published in the 'Memoranda [*sic*] of the American Academy of Arts and Sciences' the 'Plantæ Fendlerianæ.'"

He infelicitously adds, regarding Fendler—

"Fendler and he [Engelmann] had become acquainted on a governmental expedition to the Rocky Mountains, to which the former was attached as engineer. * * * He traveled in the Rocky Mountains, California, Mexico, Central America and Brazil."

Fendler did not become acquainted with Engelmann in this way; he was never attached officially to any governmental expedition; he was not an engineer; and he traveled neither in the Rocky Mountains, nor California, nor Mexico, nor Central America, nor Brazil! The writer of the paragraph can find correct information on these points in Fendler's autobiography published in this journal for June, 1885.

It is to be hoped that all botanists are taking note of the good things being provided for them at Buffalo. This meeting of the Botanical Club prom-

ises to be the largest one ever held, and being in a most interesting locality, can hardly fail of being both enjoyable and profitable. The great thing is to become acquainted with each other, and with the excursions and receptions arranged for, abundant opportunity for this will be given. Every one should come prepared to give some item to the club, the meetings of which are wholly informal. The first meeting will be held in the room assigned to biology, on Thursday morning at nine o'clock, the second day of the Association. No one interested in botany should fail to register and receive the badge of the club.

THE "HERBARIUM NUMBER" brought in so much material that it was impossible to crowd it all into our thirty-two pages. Nearly eight pages were held over and are given to our readers in this number. The stress of good material has become so great that we have been compelled to enlarge this number to thirty-six pages. Our contributors must not be deterred by this fact from continuing to send articles, but it explains the occasional delay in their appearance, a necessity regretted by no one more than the editors.

THE ONLY addition (so far as we know) to be made to the list of Engelmann's botanical papers. published in this journal for May, 1884, is his elaboration of the Euphorbiaceæ in the Bot. Mex. Bound. Survey. If the writer of of the sketch of Engelmann in the *Pop. Sci. Mo.* for June, who remarks that the list is incomplete, can add anything to it, he will confer a great favor on botanists by designating the omissions.

OPEN LETTERS.

Concerning Labels, etc.

While we are bringing together our various herbarium notions, let me say a word about labels. The point I chiefly wish to make is the importance of printing them legibly, and in good Roman type, on paper that is not too stiff. I think that one who has ever had much experience in attaching labels to the sheets will agree with me that one that curls upon itself when wet with the paste is a nuisance. Again, as the rule is to preserve the original collector's labels when sent, is it too much to ask of one in the field to make these as neat as possible? It is perfectly practicable to take with one on an excursion evenly cut slips of paper, instead of odds and ends of envelopes. Of style in labels I have spoken elsewhere; surely it exhibits the "man himself" as much as any style under heaven. I have in mind now certain examples always conducive to ophthalmia.

A word, too, concerning the forwarding of plants for exchange or identification. Do not snip off the tip end of a raceme and forward it to a botanist, without leaves, fruit, or underground parts. In fact, do nothing slovenly. I have had, and that recently, mildewed, discolored fragments sent me, and that by so-called botanists, tied together with strings, with long ribbons of paper wrapped around them for labels, and all rolled up in newspapers. With a beginner one is patient, but he loses his temper when one bedecked with collegiate degrees is guilty of such an offense. Particularly is such an occurence exasperating when the eviscerated fragments misrepresent plants which are *desiderata*.

Brown University, Providence, R. I. W. WHITMAN BAILEY.

Corrections, and a Dredge.

Please allow me to correct one or two typographical errors which occur in my article on collecting water plants, on page 139 of your last issue. I said, or meant to say, "Of the *thirty* species (of Potamogeton) found in North America," not "*thirteen* species," as you have it. On page 140 the phrase "the specimens should first be floated in water upon card-board, in the same manner as the coarser plants," should read, "floated in water upon card-board *and then dried on the board*, in the same manner," etc.

I beg leave to add a word as to a *dredge*. A very satisfactory article can be made of a small garden rake, such as is kept in almost all hardware stores for use in the flower garden. It has five or six teeth, each about two inches in length. Sometimes there are two or three teeth on the upper side also; these should be filed off, as they are liable to catch and tear the plants when wrapped about the rake. Saw off the handle of the rake, leaving about ten inches of it near the teeth, and your dredge is ready for use. It can be carried in the pocket or case till wanted, and then it may be tied to a pole, and used out of a boat or from the shore at pleasure.

For depths of water greater than eight feet, something like the crab recommended by Dr. Allen is better, but that can be used from a boat only, and is constantly liable to turn on the back, or to have the line broken by being fouled on the bottom. It does admirably for Characeæ, but the rake works better for larger aquatics.

THOMAS MORONG.

Ashland, Mass.

Exotics in the Herbarium.

It might be well for the different herbaria, now so widely distributed, to add, for the particular instruction of the public, a collection of the exotics cultivated in gardens and conservatories. These are, of course, subject to incessant additions and mutations, but are of extreme interest. Such a department might well be kept separate from the general herbarium. Perhaps my idea is not altogether possible, but I think it has good in it, and hence venture to put it forth.

W. W. BAILEY.

Brown University, Providence, R. I.

Books of Reference.

My books of reference are kept in book-cases in the room assigned to the herbarium. Thus, De Candolle's Prodromus, Walper's Repertorium, Müller's Annales, Bentham & Hooker's Genera Plantarum, and the many local floras, etc., etc., are all kept in the herbarium. In like manner the systematic literature of the lower plants is found in the same room.

I speak of this, because I know that in many places the botanical books are still considered as belonging to the general college or university library.

University of Nebraska, Lincoln, Neb. CHARLES E. BESSEY.

Herbarium for Sale.

Mrs. C. Robinson, widow of the late James F. Robinson, of Frodsham, England, being in straitened circumstances, desires to sell her husband's herbarium of British and foreign plants, valued at £30.00 for the small sum of £10.00. Her address is Main street, Frodsham, Cheshire. The specimens I have received from Mr. Robinson were excellent. It is a good chance to secure a herbarium of foreign species and to help a worthy lady who is left with seven children to bring up.

W. W. BAILEY.

Providence, R. I.

Carices Wanted.

I desire to obtain live roots of all the Carices, especially at present of C. bullata, C. glaucodea, C. formosa and C. debilis.

Agricultural College, Mich. L. H. BAILEY, JR.

CURRENT LITERATURE.

British Fungi (*Hymenomycetes*). By the Rev. John Stevenson. Vol. I., Agaricus-Bolbitius. Edinburgh: Wm. Blackwood & Sons, 1866. pp. 372. Large 12mo. Illust.

It is two years since the preliminary notice of this work was received. The part before us bears out the high estimate then given it (BOT. GAZ., 1884, p. 116), and shows that the interval has been well used to perfect it in many ways.

The complete work will embrace a second volume. The present one is mostly filled with the genus Agaricus, which covers 346 pages, and includes 782 species. The few remaining pages give 33 species of Coprinus and 7 species of Bolbitius.

The order and number of the species are essentially the same as given by M. C. Cooke in his Handbook, a revised edition of which is now publishing as a supplement to *Grevillea*. Both works are founded upon the classic writings of Fries, and it is in the translation and interpretation of these that the present work aims to be superior to anything yet offered to the public. There are other featnres which will also strongly commend themselves. The descriptions of the species have been made more comprehensive, with the diagnostic characters indicated by italics, the convenient method used for flowering plants. To the descriptions are appended ample notes giving additional items drawn from careful observations, and also comparisons between different species which must prove of especial service in determining material. There can be no doubt of the value of good measurements, and it is a pleasure to find that these have been supplied for nearly every species. The size of the spores is given in mikros, and the authority for each measurement is appended. When authorities differ the user has the advantage of independent data.

The illustrations scattered through the text—thirty-nine for this volume—are drawn to scale, and are as good as could be expected. They are by W. G. Smith; their accuracy can not be questioned.

The large number of British species, which are also found in this country, makes the publication almost as great a boon to American collectors as to their fortunate associates across the water. It is a thoroughly satisfactory handbook, being the result of superior literary knowledge and extensive practical and critical acquaintance with the plants. A number of the first mycologists of England have taken active part in its preparation, including the Rev. M. J. Berkeley. We do not doubt that its sale in this country will be sufficient to aid materially in making it evident to the publishers that such a work is demanded and appreciated.

Handbook of Mosses, with an account of their structure, classification, geographical distribution and habitats. By James E. Bagnall, A. L. S. London: Swan Sonnenschein, Le Bas & Lowrey. 12°. pp. vii. 96. 1886.

This little book is not so pretentious as its title, and will serve a good purpose in enlightening beginners as to how and where to collect mosses, and how to prepare them for permanent preservation and study. The book is specially intended for young collectors and to them it will be helpful. They should be

cautious however in relying too implicitly on the portions relating to the structure and development of the sexual organs and the fruit, where we notice some serious errors, apparently of carelessness. The engravings are poor, but at the very low price of the book (one shilling) we could hardly expect an elaborate work. It is well worth the money.

NOTES AND NEWS.

PROFESSOR CHAS. R. BARNES received the degree of Ph. D. at the last Commencement of his *Alma Mater*.

THE FOURTH VOLUME of Saccardo's Sylloge Fungorum, which includes 3,583 species belonging to the Hyphomycetes, has just been issued.

A CHEMICAL STUDY of Yucca angustifolia has been made by Helen C. DeS. Abbott of which reprints from the transactions of the Amer. Philosophical Society have been distributed.

J. C. ARTHUR received the doctorate in science during the recent commencement at Cornell University. The subject of the thesis presented was "History and biology of the pear blight."

MR. A. B. SEYMOUR, for the past year Professor of Botany in the University of Wisconsin, has resigned that position to accept the curatorship of the cryptogamic herbarium of Harvard University.

THE BIOGRAPHICAL SKETCH of the late Dr. Tuckerman in the Amherst *Record*, from which the GAZETTE notice was condensed, was written by Professor Goodell and not by Professor Tyler as was stated.

THE JUNE NUMBER of the *Pharmaceutische Rundschau* contains an interesting paper by Prof. J. M. Maisch on Mühlenberg as a botanist. We regret that lack of space prevents our giving extracts from the lecture.

MR. L. G. YATES, of Santa Barbara, Calif., is preparing a catalogue of all known ferns giving synonymy, habitat, etc. He will gladly receive and give credit for any information concerning new species, new habitats, etc.

BOTANISTS WHO have fruiting specimens of any species of Dentaria will confer a favor by sending them to Dr. Sereno Watson, Botanic Garden, Cambridge, Mass., who will be glad to repay postage and return specimens if desired.

IN THE SMITHSONIAN REPORT for 1884, just issued, Professor Theodore Gill, in his scientific record for that year in zoology, includes Myxomycetes among the Protozoans. In the bibliography of zoology, Zopf's "Die Pilzthiere oder Schleimpilze" is included.

OWING TO AN unlooked for increase in the subscription list of the GAZETTE the January issue for this year has been entirely exhausted. Unless copies can be obtained from those who have duplicates the subscriptions now coming in will have to begin with some later number.

IT IS NOTED with pleasure that the University of North Carolina has conferred the degree of LL.D. upon Dr. A. W. Chapman, of Apalachicola, Fla., and Mr. H. W. Ravenel, of Aiken, S. C. A tardy but well deserved compliment to these most eminent southern botanists.

DR. W. G. FARLOW has contributed notes on arctic algæ to the proceedings of the American Academy. They are especially interesting in the study of distribution. The collections were made by several American explorers, but principally by Mr. L. M. Turner Ungava bay.

SOME INTERESTING abnormal forms of Vaucheria are illustrated by Douglas H. Campbell in the *Amer. Naturalist* for June. The positions of the oögonia of V. geminata, var. racemosa are variously occupied by clusters of oögonia and vegetative filaments, and the antheridium in one case is replaced by a vegetative filament.

THE WEEDS against which the weed law of Wisconsin is directed are "Canada thistles, burdock, teasel, white daisy and snap dragon." There has been some doubt in the minds of the people regarding the particular plants to which these names apply, and Professor A. B. Seymour has done an excellent service in the interpretation which he has given in the third report of the Agric. Experiment Station of that state. The paper also contains much information about the habits of the plants, the history of their introduction into this country, and methods to be used in their extermination.

CALYPSO BOREALIS has not usually been credited with the possession of coralline roots. These were pointed out to Dr. Gray several years ago by Mr. Hitchings, of Boston, and the fact was called to mind lately by seeing such roots on fine specimens of this beautiful orchid brought to the Botanic Garden at Cambridge from the White Mts. by Dr. Goodale.

FROM A STUDY of Mahernia verticillata Mr. Meehan has been led to suggest as a theoretical explanation of many opposed stamens that they are developed from axial buds at the base of the petals. He does not mean to deny that in such case the stamen is not a phyllome structure, but that this structure is developed on an arrested branch and hence axillary.

THE WHOLE of Dr. M. C. Cooke's extensive herbarium of fungi has become the property of the British government, as we learn from *Grevillea*, and has been transferred to the Royal Gardens at Kew. It will be incorporated with the general collection, which is a wise thing to do. The collection of the Rev. M. J. Berkeley is at the same place, but kept distinct.

THE PROCEEDINGS of the sixth meeting of the Society for the Promotion of Agricultural Science (1885) has come to hand. It contains the following botanical articles: Vitality of seeds buried in the soil, W. J. Beal; The demands made by agriculture upon the science of botany, C. E. Bessey; Notes on injurious fungi of California, W. G. Farlow; The dandelion and the lettuce, E. R. Sturtevant; Variation in cultivated plants, W. W. Tracy.

A NUMBER of bacterial diseases of lepidopterous larvæ have been distinguished and carefully studied by Professor S. A. Forbes, of Illinois University. Artificial cultures of the bacteria were made, and the disease communicated from these to healthy larvæ. Descriptions and measurements of the bacteria are given, and the micrococcus producing flacherie in the cabbage worm is illustrated with photographs. This paper forms one of the bulletins of the Illinois State Laboratory of Natural History.

A REPORT on fruit blights and diseases of fruit trees made to the government of New Zealand by Professor T. Kirk shows that the people of that country are awake to the economic value of systematic observation and investigation in this subject. The report deals mostly with the depredations of insects. From it we learn that the most serious enemy of the apple is known as the American blight, which is a woolly aphis. What is called fire blight in the pear has no resemblance to the fire blight of this country, but is due to a parasitic fungus, a species of Roestelia. The principal obstacle to successful peach culture is the peach blight. Thousands of acres of peach orchards have been destroyed by it, and from being one of the most common fruits in the colony, it has now become the rarest. The cause is not known, but it does not appear to be due to insects. It bears no resemblance to our peach yellows. The peach yellows and pear blight of this country have not been observed in New Zealand.